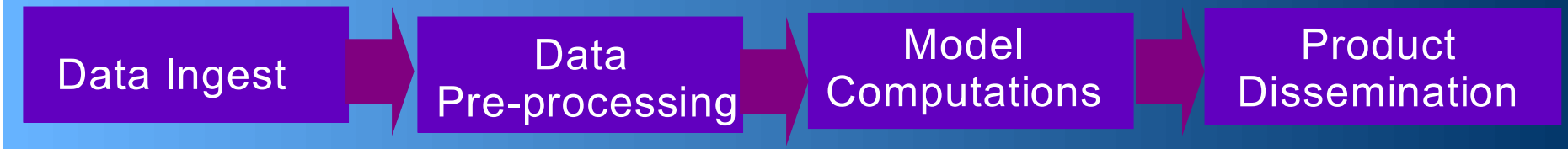
NWSRFS Overview

Functions of a River Forecast System

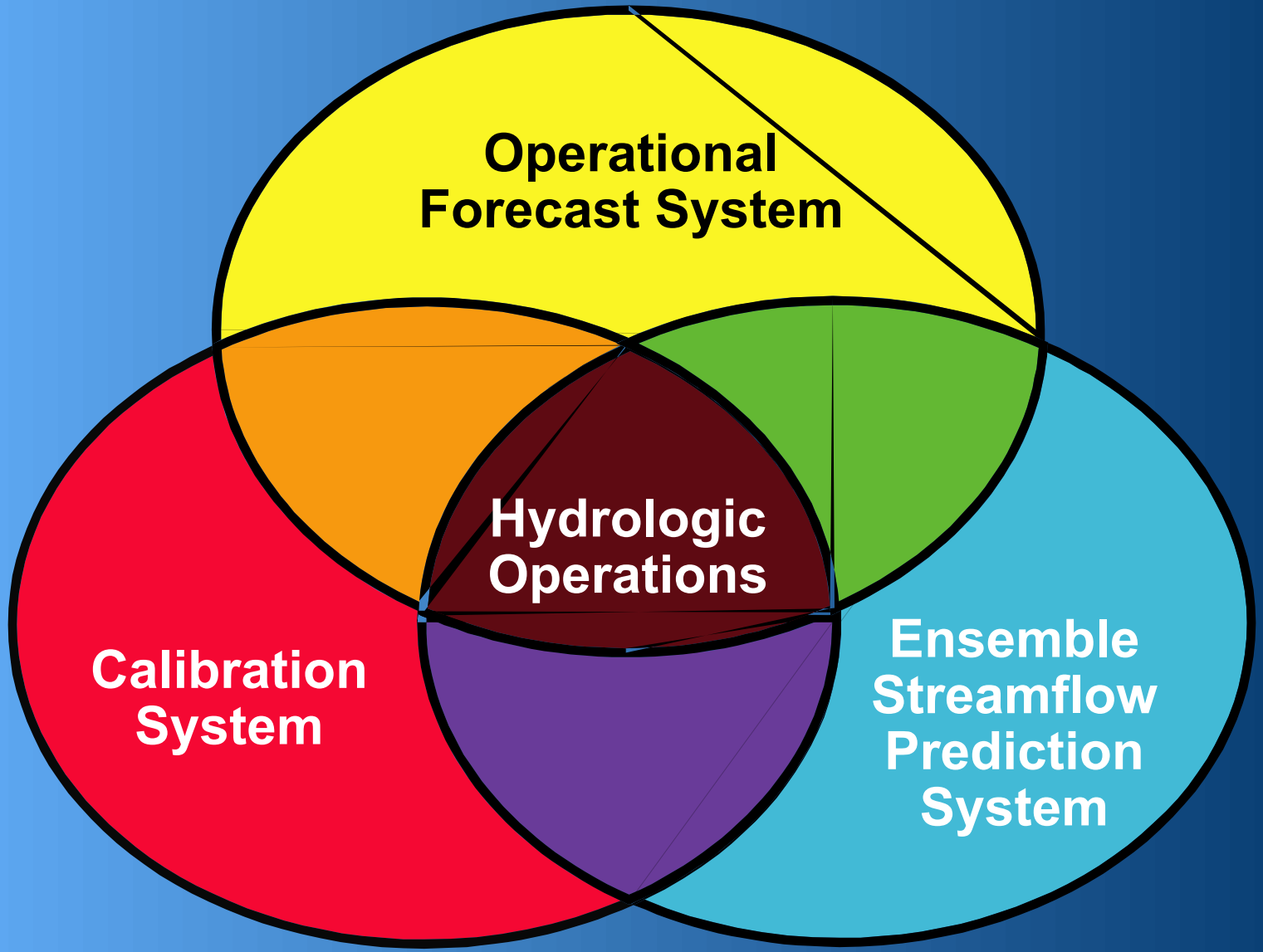


What is NWSRFS?

National Weather Service River Forecast System

- A collection of interrelated software and data stores capable of performing a wide variety of hydrologic/hydraulic functions
- Composed of 3 major functional systems that use the same hydrologic/hydraulic models

Functions of NWSRFS



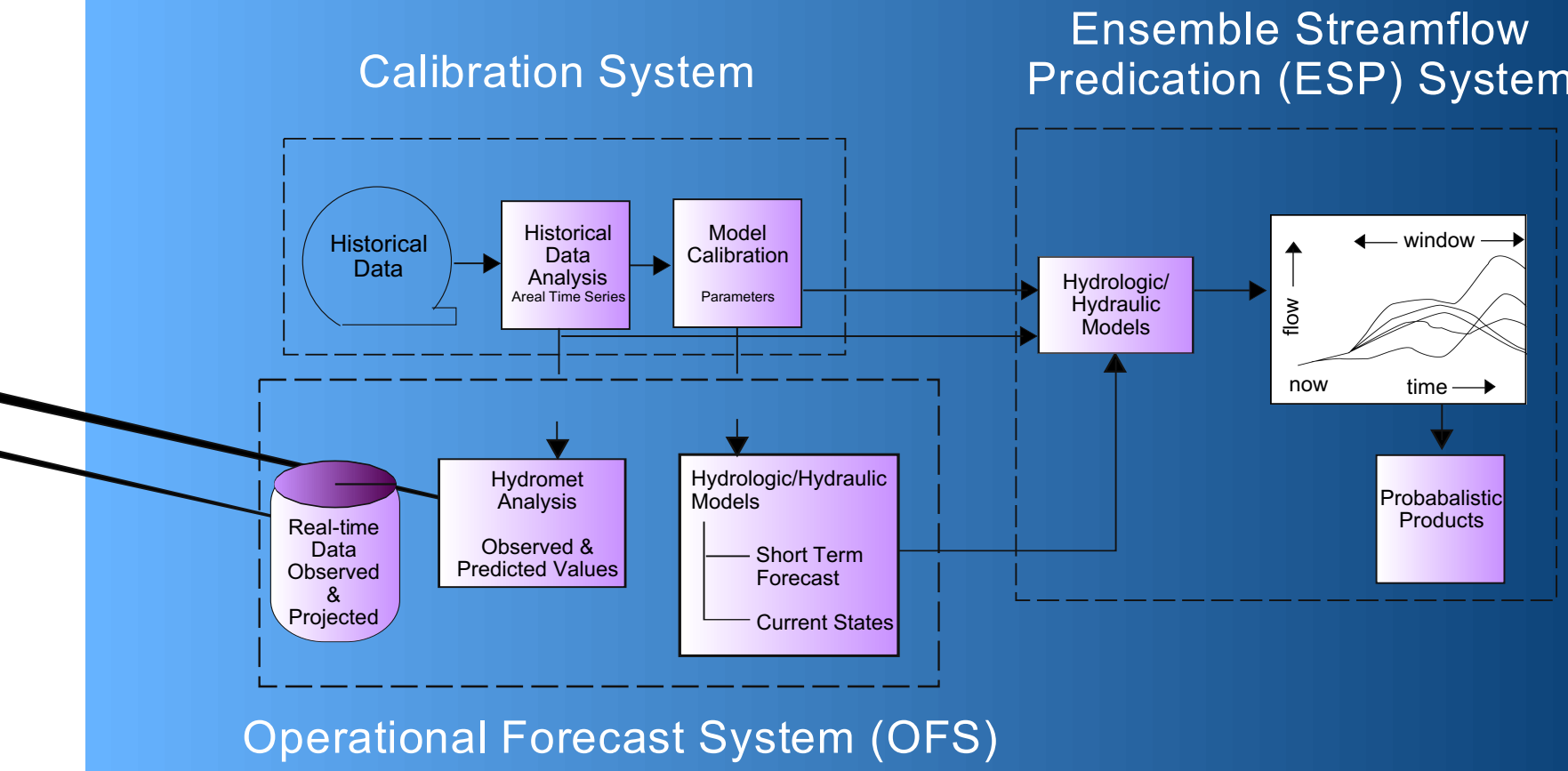
NWSRFS Functional Structure

- Calibration System (CS)
  - Generate time series based on historical data
  - Determine model parameters
- Operational Forecast System (OFS)
  - Uses calibrated parameter values to:
    - Generate short-term river and flood forecasts
    - Maintain model state variables
- Ensemble Streamflow Prediction System (ESP)
  - Uses current model states and an ensemble of time series to:
    - Generate an ensemble of hydrographs
    - Generate probabilistic short or long-term forecasts

All 3 systems use the same hydrologic and hydaulic models

NWSRFS

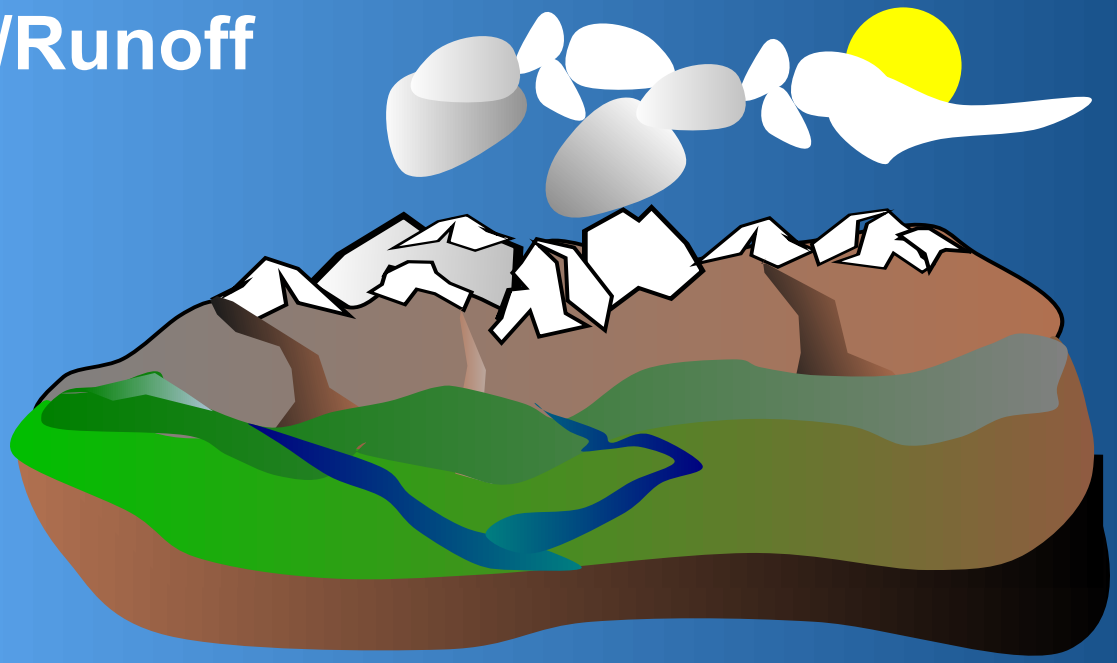
Functional Structure



River Forecasting

Hydrologic Modeling in NWSRFS

Snow
Rainfall/Runoff
Routing



NWSRFS Operation

A software routine describing the equations of motion governing the flow of water through a portion of the hydrologic cycle
For example:

- Snow Operation
  - Snow accumulation and melting
- Rainfall/Runoff Operation
  - Water flow on and below ground surface
- River Channel Routing Operation
  - Water movement from one location to another in a river

There are also many utility operations for time series manipulation, plot and tabular displays, etc. in NWSRFS

NWSRFS Operations

- 1 SAC-SMA Sacramento soil-moisture accounting model
- 2 UNIT-HG Unit hydrograph
- 3 REDO-UHG Reduced order unit hydrograph
- 4 CLEAR-TS Clear time series
- 5 SAC-PLOT Sacramento type daily flow plot
- 6 MEAN-Q Mean discharge computation
- 7 LAG/K Lag and K routing
- 8 CHANLOSS Simplified channel loss/gain
- 9 MUSKROUT Muskingum routing
- 10 ADD/SUB Add and subtract time series
- 11 LAY-COEF Layered coefficient routing
- 12 INSQPLOT Instantaneous discharge plot
- 13 TATUM Tatum routing
- 14 ADJUST-Q Flow adjustment and blend
- 15 WEIGH-TS Weight time series
- 16 STAT-QME Mean discharge statistics
- 17 WY-PLOT Water year daily flow plot
- 18 PLOT-TS General time series plot
- 19 SNOW-17 Hydro 17 snow model
- 20 CHANGE-T Change time interval
- 21 DWOPER Dynamic wave routing
- 22 SS_SAC State-space Sacramento model
- 23 STAGE-Q Stage-discharge conversion
- 24 API-CONT Continuous API model
- 25 PLOT-TUL Tulsa operational plot
- 26 RES-SNGL Single reservoir simulation model
- 27 LIST-FTW Fort Worth tabular display
- 28 CHANLEAK Conceptual channel loss model
- 29 API-MKC Kansas City API rainfall-runoff model
- 30 MERGE-TS Merge time series
- 31 SNOW-43 State-space snow model
- 32 FFG Flash flood guidance
- 33 API-CIN Cincinnati API rainfall-runoff model
- 34 API-SLC Salt Lake City API rainfall-runoff model
- 35 API-HAR Harrisburg API rainfall-runoff model
- 36 XIN-SMA Xinanjiang soil-moisture accounting
- 37 LIST-MSP Minneapolis tabular runoff display
- 38 BASEFLOW Baseflow simulation
- 39 LOOKUP Table lookup (2-variable)
- 40 WATERBAL Water balance display
- 41 API-HAR2 Harrisburg API rainfall-runoff model #2
- 42 RSNWELEV Rain-snow elevation
- 43 API-HFD Northeast RFC API rainfall-runoff model
- 44 SARROUTE SSARR multi-phase routing
- 45 DELTA-TS Change in time series values
- 46 NOMSNG Generate no missing value time series
- 47 PEAKFLOW Comparison of peak flows
- 48 MULT/DIV Multiply and divide time series
- 49 BEGASSIM Begin assimilator loop
- 50 ASSIM Assimilator updating
- 51 SSARRESV SSARR reservoir regulation
- 52 SUMPOINT SSARR summing point
- 53 LOOKUP3 Table lookup (3-variable)
- 54 SWB-NILE Simple water balance model
- 55 FLDWAV Generalized Flood Wave Routing
- 56 GLACIER AKRFC Glacier model
- 57 CONS_USE Consumptive Use model
- 58 RES-J Joint reservoir model
- 59 TIDEREV Tide balance review
- 60 ADJUST-T Tide adjustment
- 61 STAGEREV Review stage
- 62 ADJUST-H Stage adjustment

History Highlights

- Early 1970s - First components developed
  CALB - MAP, MAT, MCP, OPT
- Mid-late 1970s NWSRFS Versions 1-4
- 1979-83 Version 5 developed -first field test ABRFC
- 1985 - OFS general release on mainframe at CCF
- 1989-91 port of OFS to UNIX; development of Interactive Forecast Program (IFP)
- 1997 Interactive Calibration Program (ICP) released
- 1998 Ensemble Streamflow Prediction Analysis and Display Program (ESPADP) released

NWSRFS Version 5

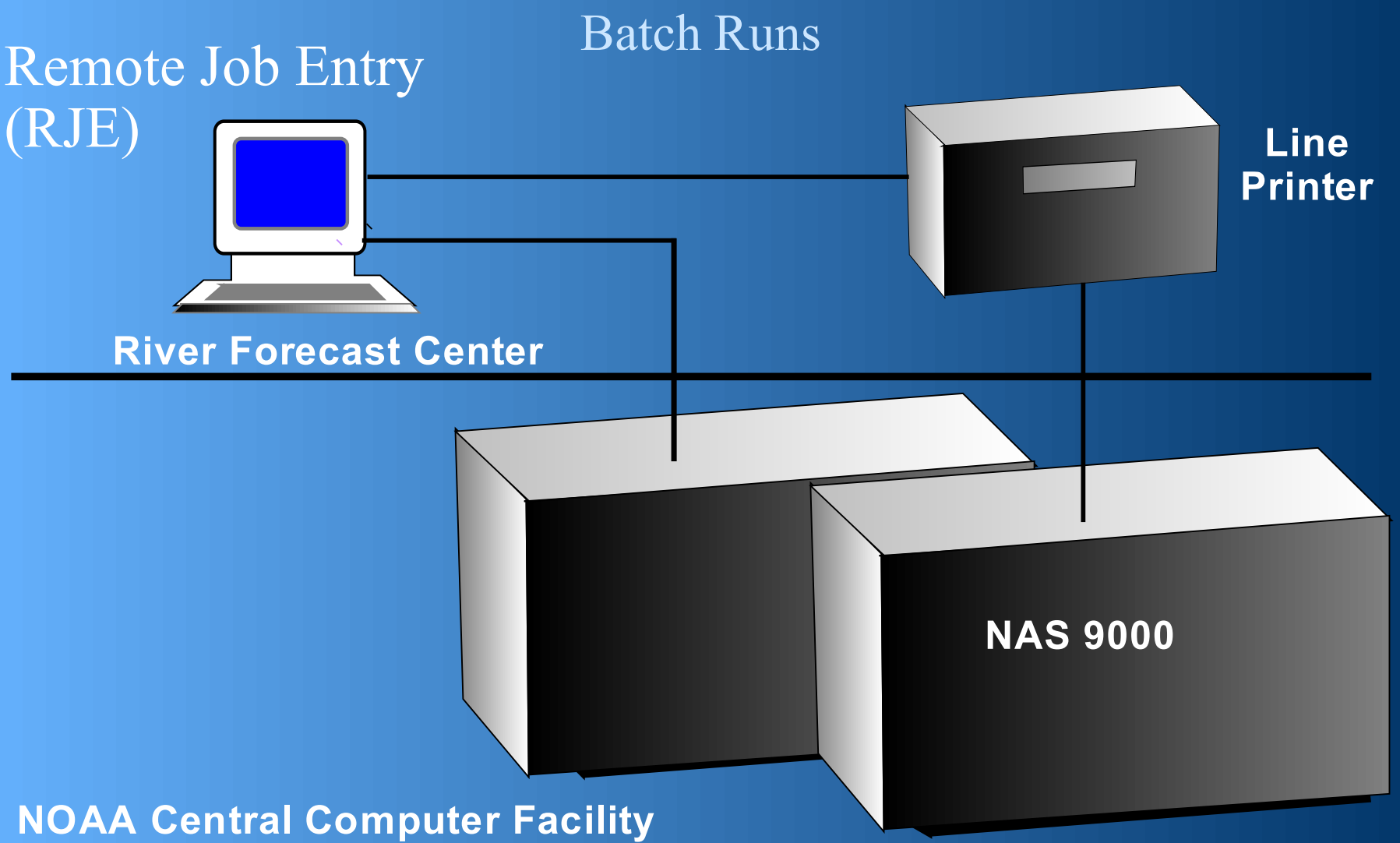
Functional Requirements

- Allow for a variety of models and procedures.
- User controls selection of models and method of use.
- Easy to add new models and procedures to keep up with science and technological changes.
- Efficiently process large amounts of data to produce forecasts at hundreds of locations for each RFC.
- Flexible user control of real-time processing.

Current Status

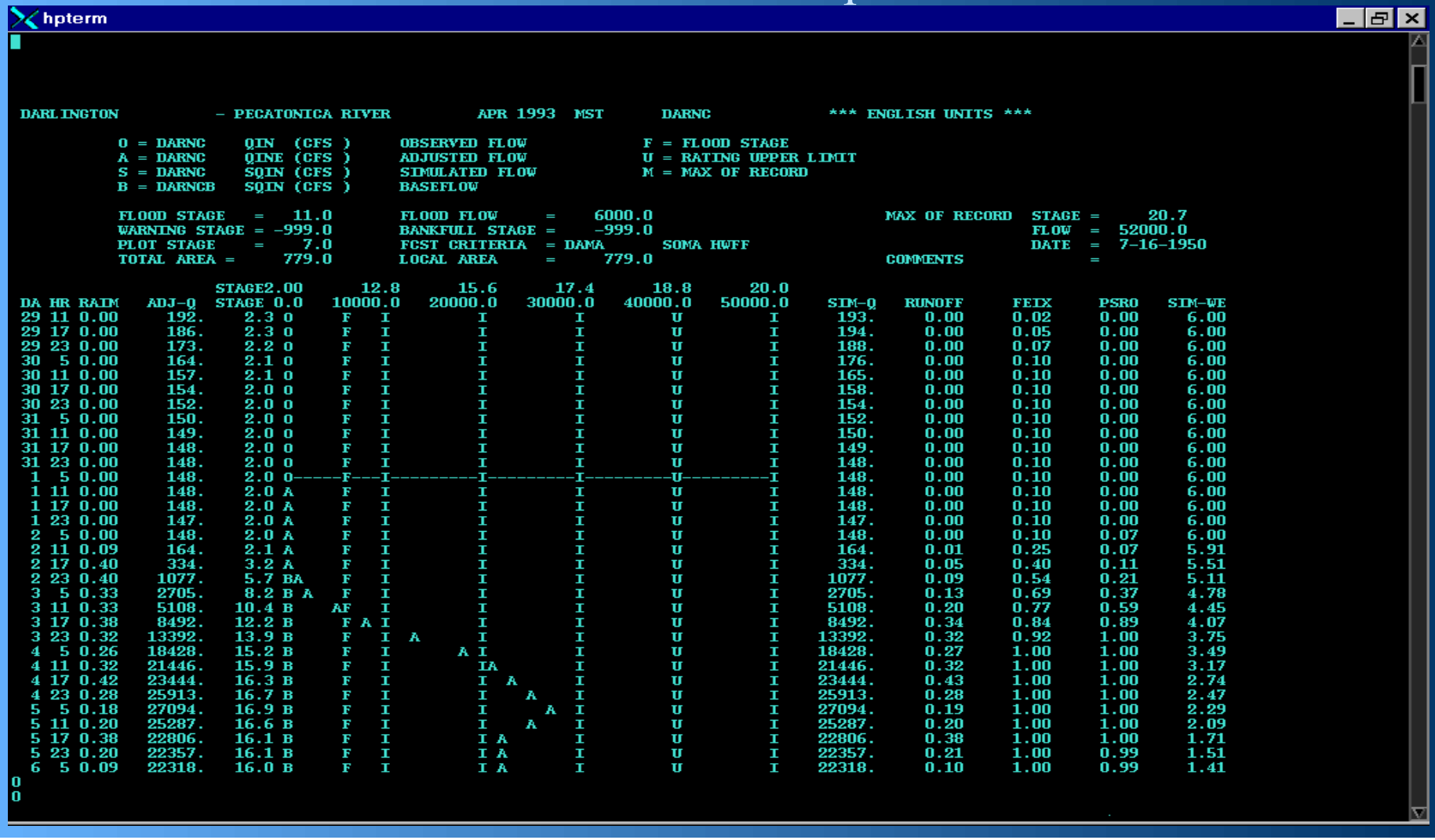
- Implementation
  - US - 13 River Forecast Centers - ~4000 Forecast Points
  - 5 additional countries (China, Czech Republic, Mexico, Panama, South Africa)
  - Plans for 2 more countries (Honduras, Venezuela)
- Features
  - 62 Operations - recent additions include RES-J and FLDWAV
  - Current work on expanding ensemble forecast capabilities
  - Automated model updating
  - Interactive calibration, operational model control, and ensemble analysis

Pre-AWIPS NWSRFS



NWSRFS Version 5

Line Printer Output



hpterm

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DARLINGTON          - PECATONICA RIVER          APR 1993  MST      DARNC            *** ENGLISH UNITS ***

          O = DARNC     QIN  (CFS )     OBSERVED FLOW            F = FLOOD STAGE
          A = DARNC     QINE (CFS )     ADJUSTED FLOW            U = RATING UPPER LIMIT
          S = DARNC     SQIN (CFS )     SIMULATED FLOW           M = MAX OF RECORD
          B = DARNCB    SQIN (CFS )     BASEFLOW

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          WARNING STAGE  = -999.0       BANKFULL STAGE  =    -999.0                                   FLOW  =  52000.0
          PLOT STAGE     =    7.0       FCST CRITERIA   = DAMA      SOMA HWFF                         DATE  =  7-16-1950
          TOTAL AREA =     779.0       LOCAL AREA      =     779.0                    COMMENTS                =

                    STAGE2.00      12.8      15.6      17.4      18.8      20.0
 DA HR RAIM    ADJ-Q  STAGE 0.0   10000.0   20000.0   30000.0   40000.0   50000.0    SIM-Q    RUNOFF     FEIX     PSRO    SIM-WE
 29 11 0.00      192.     2.3 O     F   I         I         I         U         I      193.      0.00     0.02     0.00      6.00
 29 17 0.00      186.     2.3 O     F   I         I         I         U         I      194.      0.00     0.05     0.00      6.00
 29 23 0.00      173.     2.2 O     F   I         I         I         U         I      188.      0.00     0.07     0.00      6.00
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 30 17 0.00      154.     2.0 O     F   I         I         I         U         I      158.      0.00     0.10     0.00      6.00
 30 23 0.00      152.     2.0 O     F   I         I         I         U         I      154.      0.00     0.10     0.00      6.00
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 31 23 0.00      148.     2.0 O     F   I         I         I         U         I      148.      0.00     0.10     0.00      6.00
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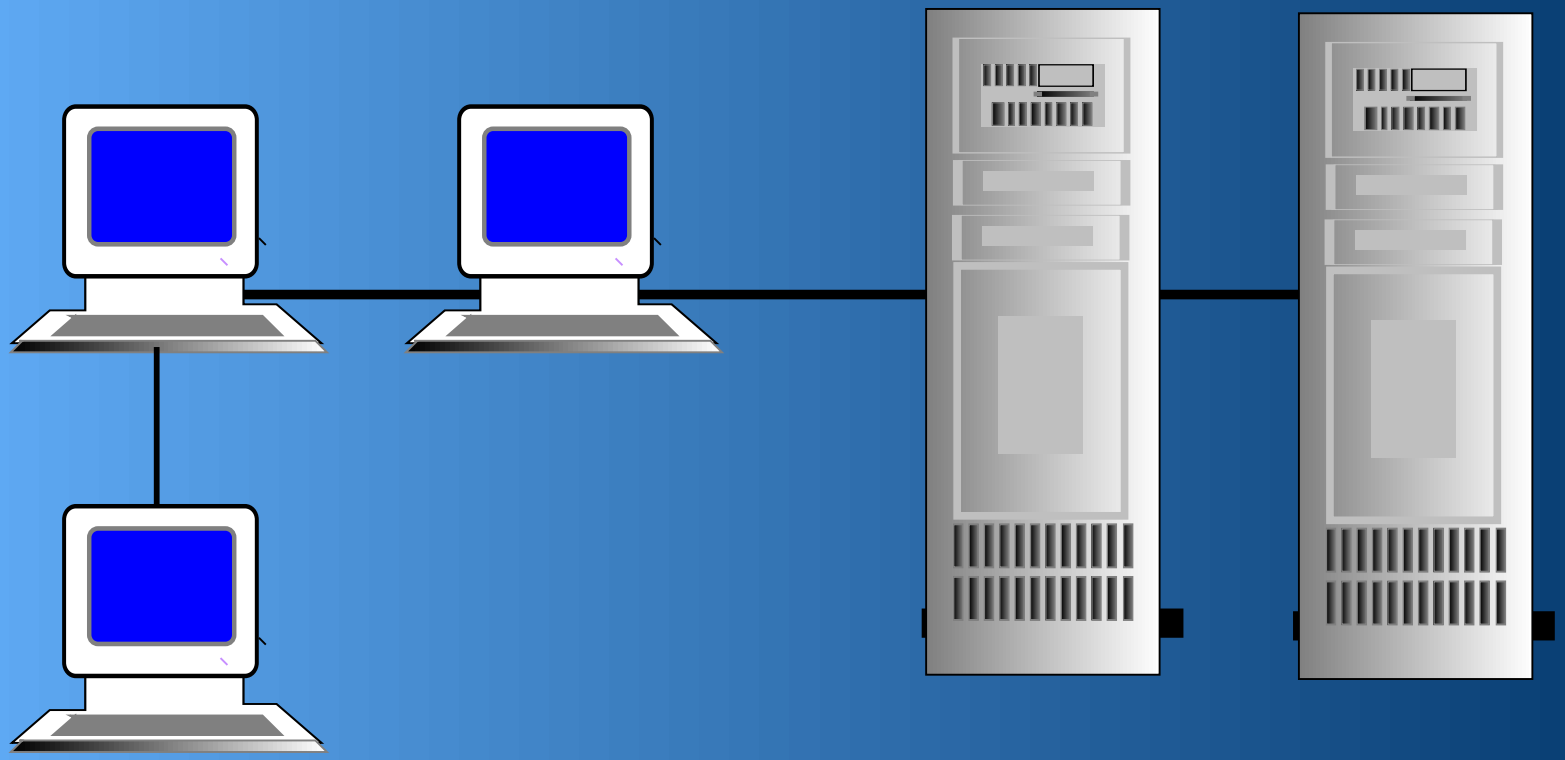
Transition to AWIPS

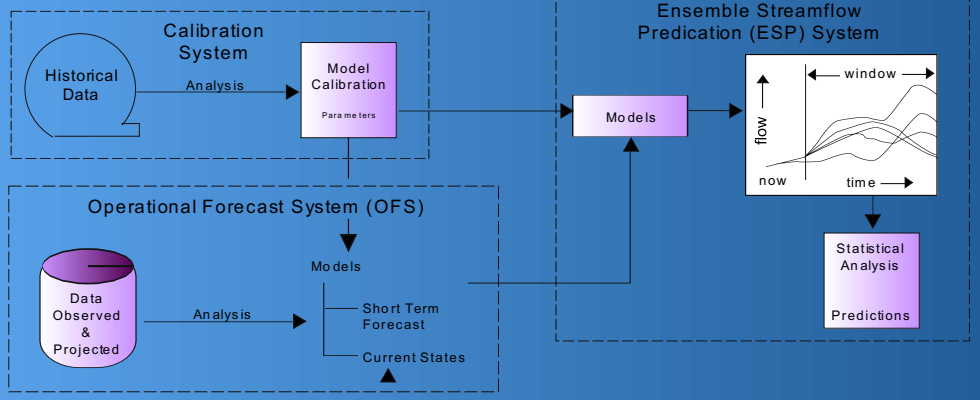
Local Processing

Networked File Servers and Scientific Workstations



Modernized NWSRFS

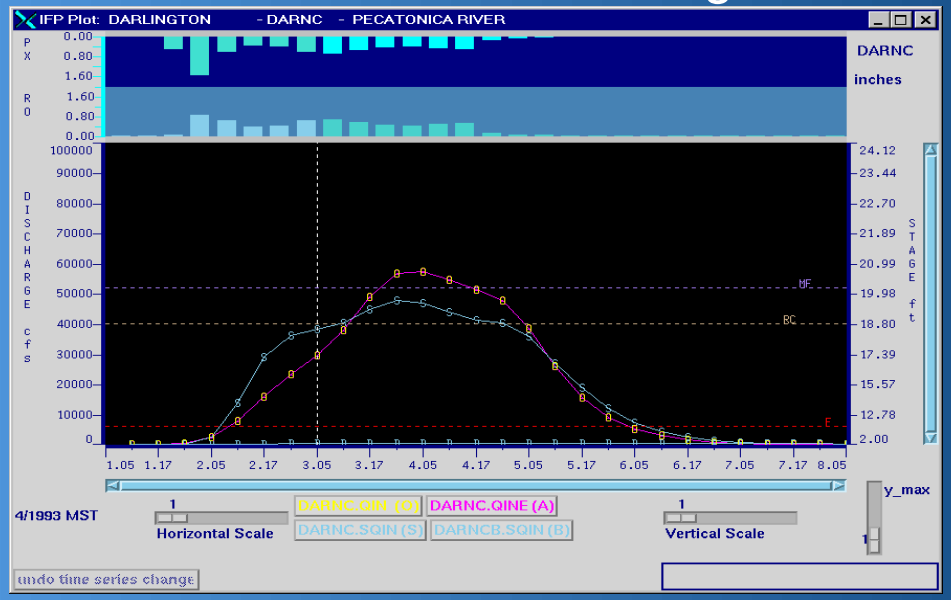
Interactive
Calibration
Program



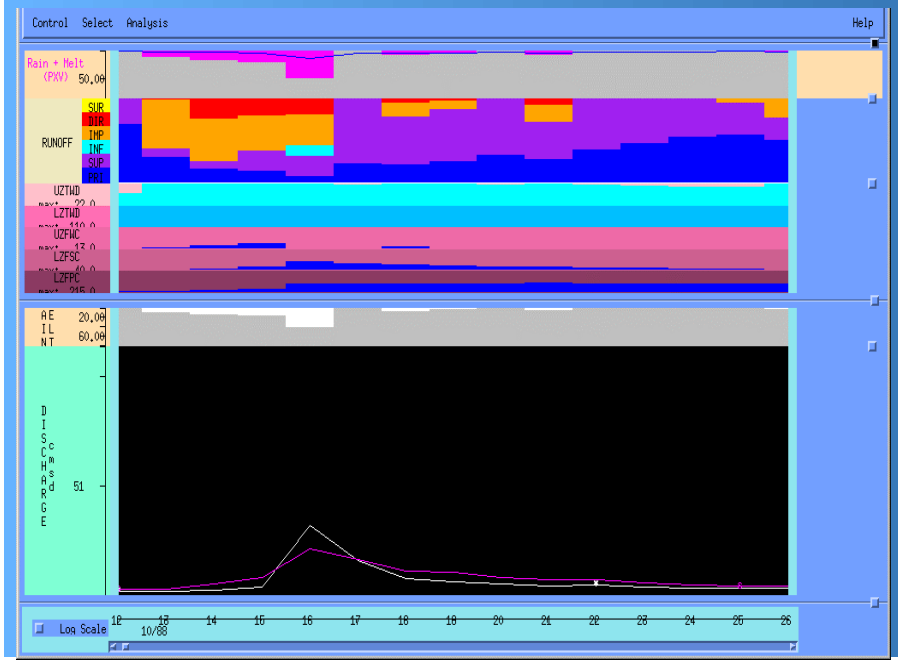
Ensemble
Streamflow
Prediction
Analysis &
Display **P**rogram

Interactive
Forecast
Program

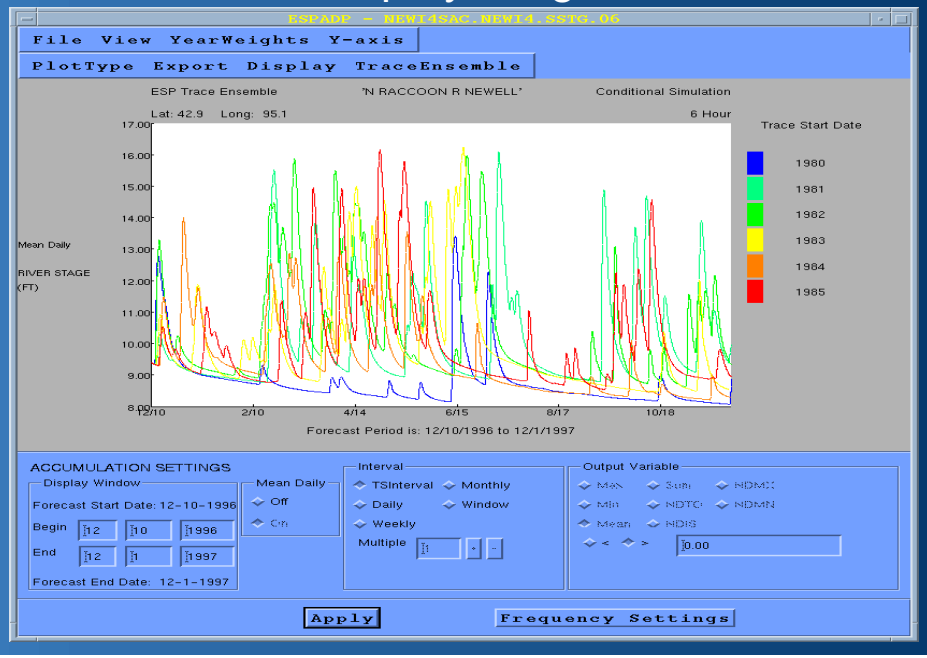
Interactive Forecast Program



Interactive Calibration Program



Ensemble StreamflowPrediction Analysis & Display Program



Organization of NWSRFS Users Manual

Highlighting OFS and ESP information

I. General Information
II. Model/Procedure Description - Scientific Information
III. Historical Data Access and Analysis - User Information
IV. Model Calibration - User and Guideline Information
V. Operation Definition Information
VI. OFS and ESP User Information
    VI.3 Initialization Programs
    VI.4 Data Entry
    VI.5 FCST/HCL
    VI.6 Utility Programs

Organization of NWSRFS Users Manual

Continued

VII. Calibration - System Documentation
VIII. Operations - System Documentation
IX. OFS/ESP - System Documentation
X. RFC Application Software Information

Online documentation at:

http://hsp.nws.noaa.gov/oh/hrl/nwsrfs/users_manual/htm/formats.htm